Final 2016

1

a) There are no. clear boundaries ..... Consider three types low-, mid-, high-level . Explain

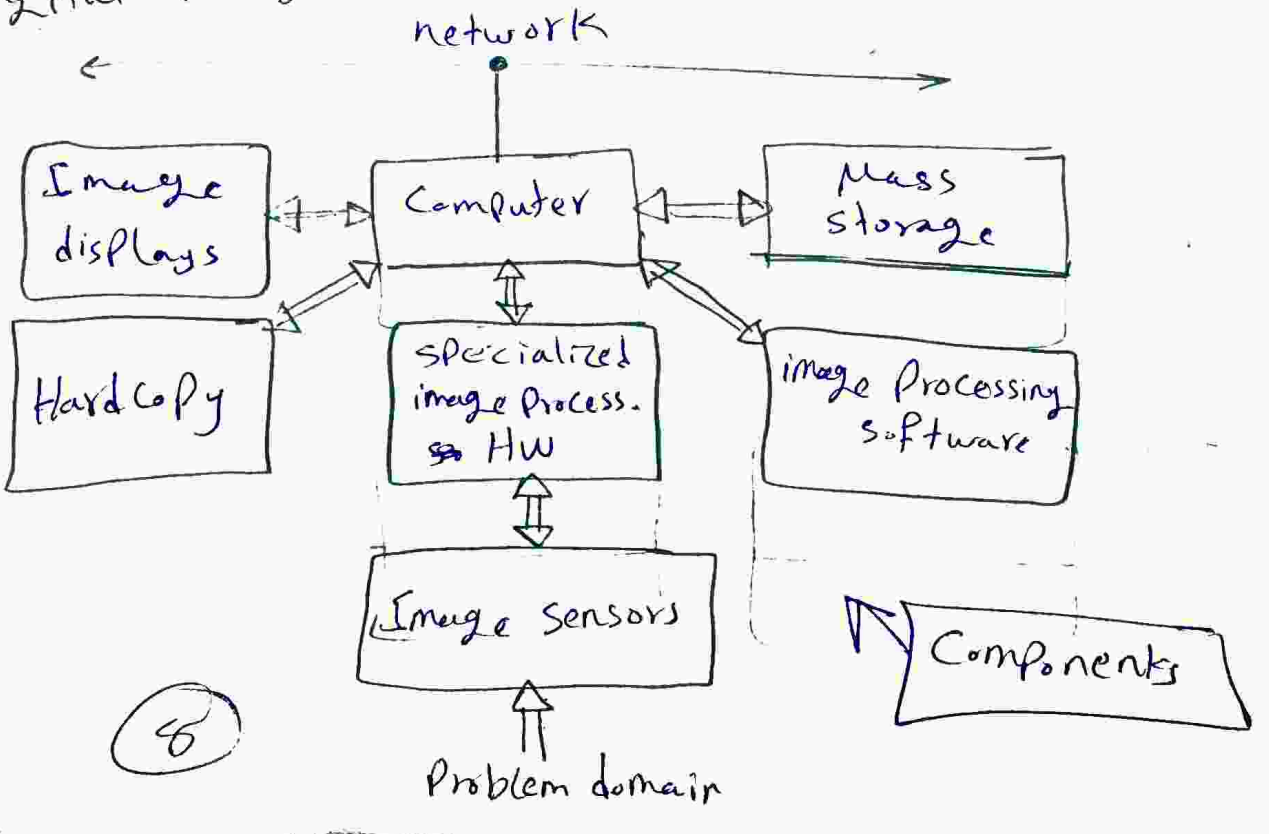
5.1

low level → o/p is improved image
↳ ex: improve constrant & reduce noise

mid-level → o/p is extracting features from image
↳ ex: extract characters from image.

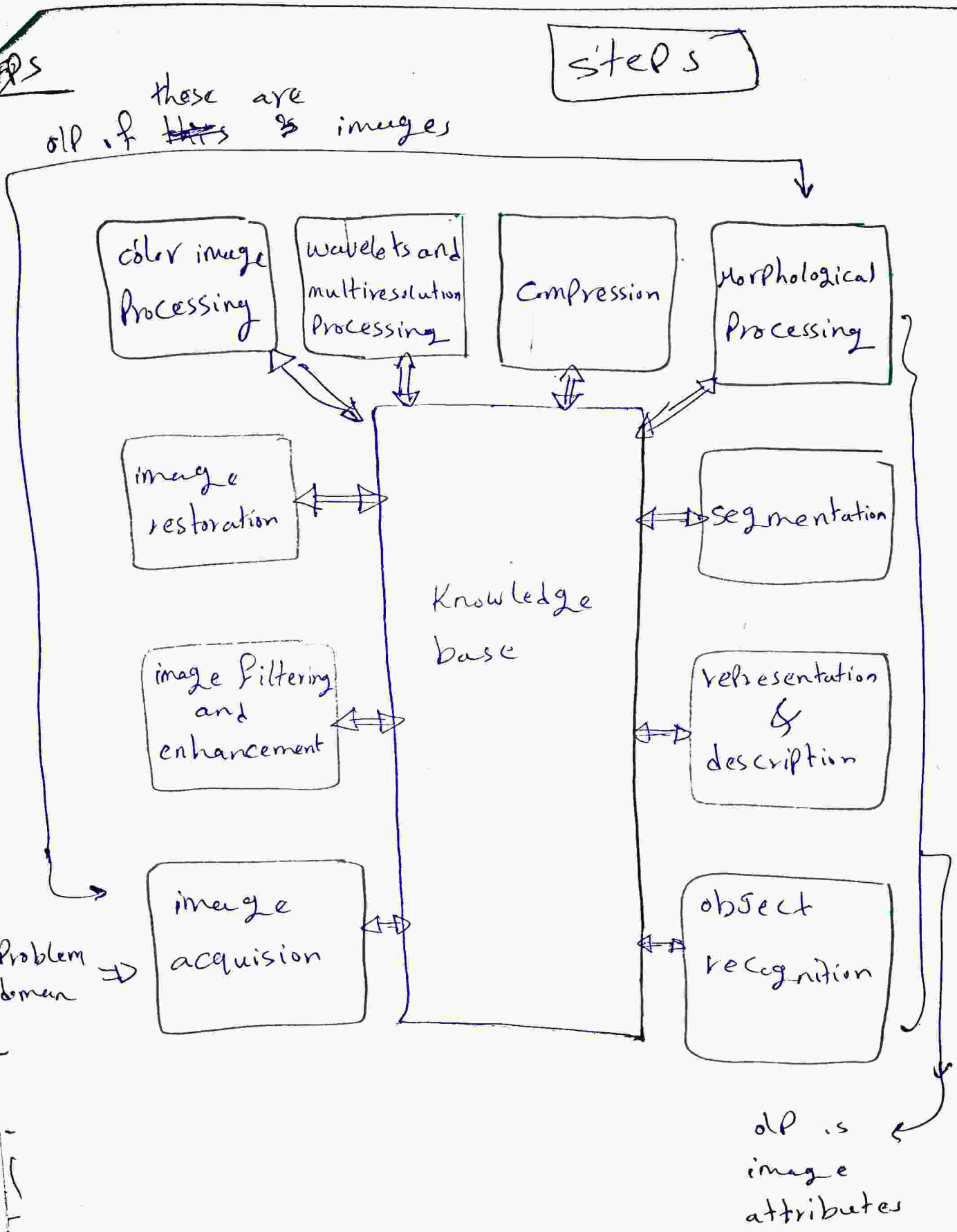
high-level → o/p is interpretation of image.
↳ ex: interpreting characters in image

b) using block diagram show steps & components in digital image ?



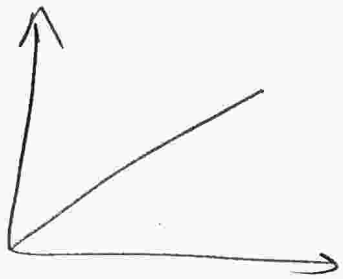
8

steps


these are
olp of images
color image Processing
wavelets and multiresolution Processing
Compression
Morphological Processing
image restoration
segmentation
Knowledge base
image filtering and enhancement
representation & description
image acquision
object recognition
Problem domain
olp is image attributes

c. Discuss three different representation of digital images. show context which each of them is used.

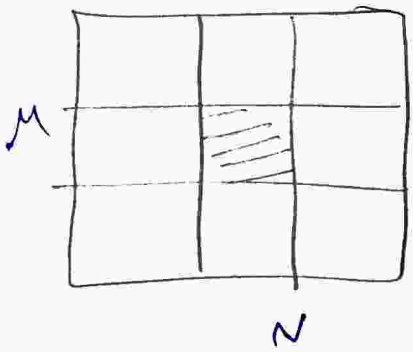
1) surface (3D image)
↳ image where two dimension represent spatial coordinates (x, y) and 3rd dimension is intensity level



2) Image for human : (2D image)
↳ used by humans to see objected.

3) Array image (used in algorithms)
↳ image is represented as matrix of values

$L = 2^K$ ⇒ no. of intensity level



Prove that fourier transform kernels are separable and symmetric

$$r(x,y,u,v) = e^{-j2\pi\left(\frac{ux}{M}+\frac{vy}{N}\right)}$$

$$s(x,y,u,v) = \frac{1}{MN} e^{j2\pi\left(\frac{ux}{M}+\frac{vy}{N}\right)}$$

Sol

1st

$$r(x,y,u,v) = e^{-j2\pi\frac{ux}{M}} \cdot e^{-j2\pi\frac{vy}{N}}$$

$$= r_1(x,u) \cdot r_2(y,v)$$

↳ so, it is separable & symmetric (same form)

$$s(x,y,u,v) = \frac{1}{MN} e^{j2\pi\frac{ux}{M}} \cdot e^{j2\pi\frac{vy}{N}}$$

$$= \frac{1}{MN} r_1(x,u) \cdot r_2(y,v)$$

3 3-bit image (64 x 64 Pixels "M*N = 4096")

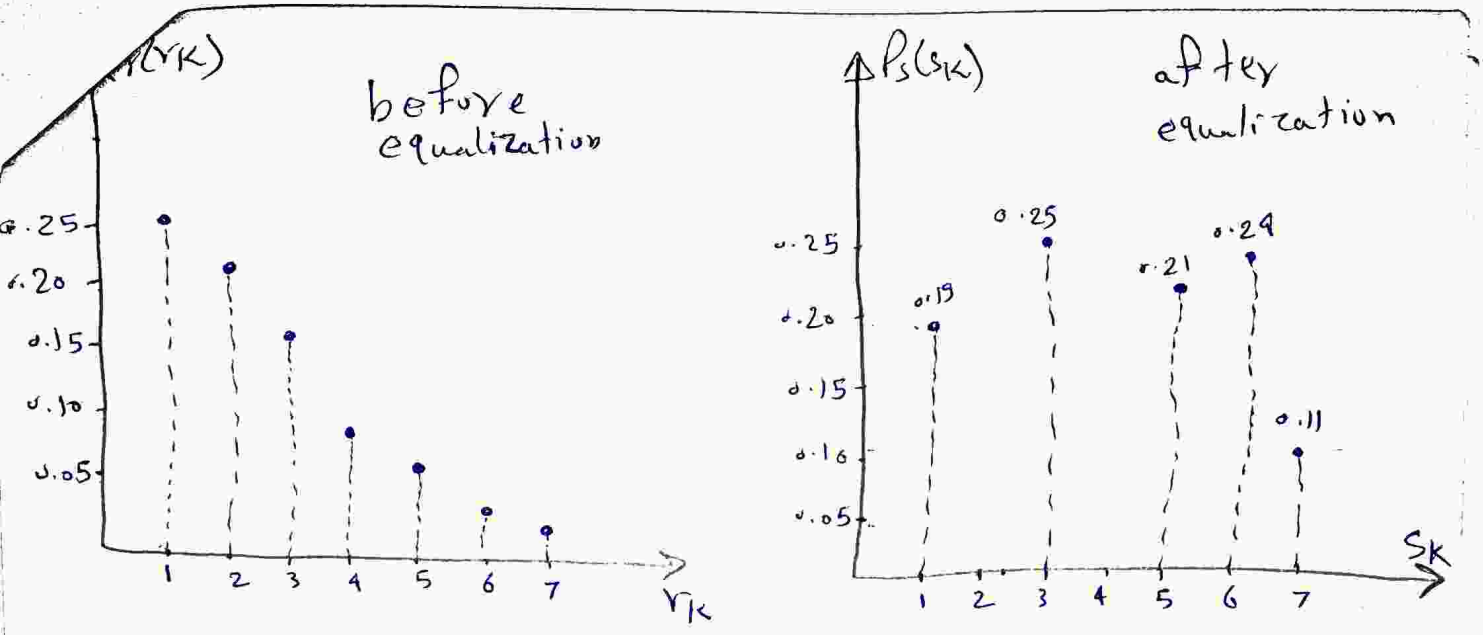
1) Calculate & sketch histogram components for image

2) Calculate & sketch histogram components after application of histogram equalization

$$S_K \; sT(r_K) = \frac{L-1}{MN} \sum_{j=1}^{K} n_j$$

r_K	n_K	$P_r(r_K) = \frac{n_K}{MN}$
r_0	790	0.19
r_1	1023	0.25
r_2	850	0.21
r_3	656	0.16
r_4	329	0.08
r_5	245	0.06
r_6	122	0.03
r_7	81	0.02

r_K	S_K
r_0	1.35 → 1
r_1	3.08 → 3
r_2	4.55 → 5
r_3	5.67 → 6
r_4	6.23 → 6
r_5	6.65 → 7
r_6	6.85 → 7
r_7	6.98 → 7



b) Find intensity value of circuled pixel

~~1) after a~~

124	115	130	122	140
126	130	128	135	145
131	133	(136)	140	150
142	150	148	160	163
149	153	151	162	166

4) apply 3x3 median filter

130	128	135
133	136	140
150	148	160

→

128	130	133
135	136	140
148	150	160

Value of intensity = 136

2) After Apply filter below using convolution techn

-1	-1	-1
1	4	1
-1	-1	-1

130	128	135
133	136	140
150	148	160

value = (-1 * 130) - 128 -135 + 133 + 4 * 136 + 140 - 150

- 148 - 160 = 226

4

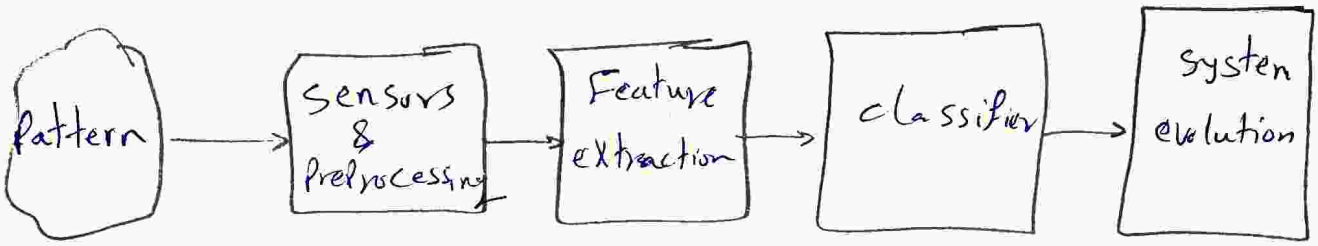
a) What are performance criteria of pattern recognition algorithms?

1) Robustness → does it tolerate reasonable amount of noise? relate

2) efficiency → How much time & memory required to search the solution space.

3) Accuracy
   - correct recognition (High recognition rate)
   - False positives (wrong ")
   - " negatives (missed ")

Describe different components of pattern recognition in detail?



pattern → set of instances that
a. share same regularities & similarities.
b. is repeated.
c. is observable.
d. may have some noise

sensors → like ~~Cam~~ video cameras
↳ image acquision device.

Preprocessing → includes noise reduction & scaling

Features → measurable quantities that distinguish patterns from each other

classifier: divide feature space into regions that correspond to different classes and assign pattern which dis criminative features to prescribed class.

ex
↳ neural network ↳ Decision trees
↳ K-nearst neighbor ↳ Bayesian classifier

c. EXPlain Bayesian classifier and state its assumptions?

let $w_1, w_2 \rightarrow$ two classes (which our Pattern belong)

assume $P(w_1)$, $P(w_2)$ Known

$$P(w_1) \simeq \frac{N_1}{N} \quad ; \quad P(w_2) \simeq \frac{N_2}{N}$$

$$P(w_i|x) = \frac{P(x|w_i)\,P(w_i)}{P(x)} \quad \& \text{ Postperior} = \frac{\text{likelihood} \times \text{Perior}}{\text{evidence}}$$

$P(x|w_i)$, $i = 1,2$ class conditional Probability

→ assume no other types of fish

$$P(w_1) + P(w_2) = 1 \Rightarrow P(x) = \sum_{i=1}^{2} P(x|w_i)\,P(w_i)$$

Baysian rule

if $P(w_1|x) > P(w_2|x)$; $x \rightarrow$ classified to w_1

if $P(w_1|x) < P(w_2|x)$; $x \rightarrow$ " " w_2.

Consider image Cameraman.tif Write matlab code for :-

a) Rotate image with 60° clockwise

```
C = imread("Cameraman.tif")
B = imrotate (C, 60)
```

b) washout image using two arithmetic operations

$Y = a * image + b$

a → raise brightness

b → change contrast

$Y = 2C + 3$ Put any values 7 1

c) generate 3x3 Gaussian mask with sigma 0.5 and apply mask on image.

~~I = rgb2gray(C);~~

```
H = fspecial('gaussian', * 3 3), 0.5)
```

d) Show the entire translated image after performing translation operation shifts image B by 20 pixels in x-direction & 30 pixels in y direction

```
B = Imtranslate(X, (20, 30))
```

e) write translated image in d into file of types JPEG and specify its size on storage disk

imwrite(B, 'Cameraman', 'quality', 9) → لو حطنا ال تكبر دي ال size

9 → from 0 to 100 → compression level

J = imnoise(C, 'salt & pepper', 0.02) → add noise

B = imfilter(J, H)

D = medfilter2(J, [3 3]) → median filter
